RESTRICTED SELECTION IN FINGER MILLET [*ELEUSINE CORACANA* (L.) GAERTN] FOR NUTRITIONAL AND YIELD COMPONENTS

P. SRILAKSHMI[1] & D. RATNA BABU[2]

[1]*Department of Genetics and Plant Breeding, Agricultural College, Bapatla, Andhra Pradesh, India*

[2]*Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh, India*

ABSTRACT

Restricted selection was used for estimating the genetic advance of nutritional and yield components viz., seed protein content, seed calcium content, plant height, days to 50% flowering, days to maturity, number of productive tillers per plant, fingers per ear, finger length, ear weight per plant, 1000-seed weight, and seed yield per plant. The genetic advance of all the eleven characters under study was estimated by assigning equal economic weights to all characters as well as by using inverse of means as economic weights. In both the cases the 1000-seed weight recorded height values of genetic advance. The important finding of the present investigation is the occurrence of similar trend in both cases i.e., by taking equal economic weights and using inverse of means of respective characters as economic weights. This indicates that both the ways of assigning weights were equally effective and will result in similar conclusions.

KEYWORDS: Restricted Selection, Finger Millet

Original Article

INTRODUCTION

Finger millet [*Eleusine coracana* (L.) Gaertn.] also known as African millet or ragi, is a self pollinated tetraploid (2n = 36) crop. It is the most important small millet cultivated in more than 25 countries in Africa and Asia. The major producers are Uganda, India, Nepal and China. India is the major producer in Asia and in India, it is widely grown in the states of Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, Orissa, Gujarat, Jharkhand, Uttar Pradesh, Madhya Pradesh and Uttarakhand. In India, it is cultivated on 1.1 M ha, with a production of 1.9 Mt and a productivity of 1.6 t ha^{-1} while in Andhra Pradesh it is grown in an area of 41,000 ha with a production of 40,000 t and a productivity of 1.19 t ha^{-1} (Ministry of Agriculture, 2013). In spite of its high nutritional value and wider adaptability its productivity levels are far less than actual yield potential (10 t ha^{-1} under optimum conditions). For improving the yield levels different breeding programmes are available based on different kinds of selection techniques. Under certain situations the breeder might like to effect change in means of some characters while keeping the means of other characters unchanged. To enable this kind of selection Kempthrone and Nordskog (1959) introduced the concept of "restricted selection indices" which enables us to restrict change in only some characters without affecting the development in other characters.

MATERIALS AND METHODS

The present investigation was carried with forty three diverse finger millet genotypes obtained from Agricultural Research Station (ARS), Vizianagaram, Andhra Pradesh at Agricultural College Farm, Bapatla, Guntur District, Andhra Pradesh, which is located at an altitude of 5.4 m MSL, 15^0 54' N latitude and 80^{0}90' E

longitude. Restricted selection was carried out for eleven different nutritional and yield components *viz.,* seed protein content, seed calcium content, plant height, days to 50% flowering, days to maturity, number of productive tillers per plant, fingers per ear, finger length, ear weight per plant, 1000-seed weight, and seed yield per plant. Material was sown in Randomized Complete Block Design and observations were recorded on ten randomly selected plants per treatment per replication and their means were used for statistical analysis. However, seed protein, seed calcium content days to 50% flowering, days to maturity and 1000-seed weight were recorded on plot basis. protein content (%) of each sample was estimated as described by Sadasivam and Manickam (1996) and the seed calcium content in the sample was estimated by Versenate titration method (Jackson, 1967).

Among the eleven characters taken for present study selection was restricted to only ten characters at a time without changing the mean of remaining eleventh character. All such eleven possible cases were worked out according to Singh and Chaudhary (2010) and the genetic advances for the ten characters subjected to selection in each of the eleven cases were estimated.

RESULTS AND DISCUSSIONS

The estimates of genetic advances of all the ten characters in each of the eleven cases, when equal economic weights were assigned are presented in the table 1.

In the first case when selection is restricted to ten characters without affecting the mean of plant height, highest estimate of genetic advance was recorded in case of 1000 seed weight (4.8458) followed by productive tillers per plant (3.4130) and days to 50% flowering (1.0677) while the least estimate was observed for finger length (-0.1007).

In the second case when selection is restricted to ten characters without affecting the mean of days to 50% flowering, highest estimate of genetic advance was recorded by 1000 seed weight (4.5248) followed by productive tillers per plant (1.9566) and seed calcium content (1.0200) while the least value was observed for fingers per ear (-0.4393).

In the third case when selection is not applied on days to maturity, the highest estimate of genetic advance was recorded by 1000 seed weight (3.3888) followed by seed yield per plant (1.0782) and days to 50% flowering (1.0554) while the least value was observed for fingers per ear (0.1205).

In the fourth case where productive tillers per plant was not subjected to selection the highest estimate of genetic advance among the remaining ten characters was recorded by 1000 seed weight (4.1014) followed by seed yield per plant (1.0961) and days to 50% flowering (1.0813) while the least value was observed for fingers per ear (-0.3521).

In the fifth case when selection is restricted to ten characters leaving fingers per ear, the highest estimate of genetic advance was recorded by 1000-seed weight (3.1312) followed by days to 50% flowering (1.0895) and seed calcium content (1.0207) while the least value was recorded by finger length (0.2391).

In the sixth case where finger length is not considered for selection, the highest estimate of genetic advance among the remaining ten characters was recorded by 1000- seed weight (3.4135) followed by productive tillers per plant (1.1134) and days to 50% flowering (1.0589) and least by fingers per ear (-0.2911).

In the seventh case when selection is restricted to ten characters without affecting ear weight per plant, highest estimate of genetic advance was recorded by 1000-seed weight (3.8515) followed by days to 50% flowering (1.0573) and seed yield per plant (1.0359) while the least value was observed for fingers per ear (-0.1770).

In the eighth case when selection is imposed on the combination of ten characters which does not include 1000 seed weight, highest estimate of genetic advance was recorded by productive tillers per plant (1.4706) followed by seed yield per plant (1.1369) and days to 50% flowering (1.1094) and least value was observed for fingers per ear (-0.0157).

In the ninth case when selection is restricted to the combination of ten characters which does not include seed protein content, highest estimate of genetic advance was recorded by 1000-seed weight (4.3931) followed by seed yield per plant (1.0789) and days to 50% flowering (1.0551) while the least value was observed for fingers per ear (-0.4182).

In the tenth case when selection is restricted to the combination of ten characters which does not include seed calcium content, highest estimate of genetic advance was observed for 1000 seed weight (3.2891) followed by productive tillers per plant (2.1599) and days to 50% flowering (1.1012). However seed protein content (0.3595) recorded least value of genetic advance.

In the eleventh case when selection is restricted to the combination of ten characters which does not include seed yield per plant, highest estimate of genetic advance was recorded by 1000 seed weight (3.9961) followed by productive tillers per plant (1.9349) and days to 50% flowering (1.0764) while the least value was observed by fingers per ear (-0.3555).

In all the above eleven cases of restricted selections, the character 1000-seed weight recorded highest estimate of genetic advance except when the same character is not consider for selection *i.e.*, in the eighth case of restricted selection (Table 1.).

Similarly the estimates of genetic advances of all the ten characters in each of the eleven cases, when inverse of means were used as economic weights are presented in the table 2. In the first case when selection is restricted to ten characters without affecting the mean of plant height, highest estimate of genetic advance was recorded by 1000 seed weight (0.5992) followed by productive tillers per plant (0.2464) and finger length (0.1229) while the least estimate was observed for seed calcium content (0.0037).

In the second case when selection is restricted to ten characters without affecting the mean of days to 50% flowering, highest estimate of genetic advance was recorded by 1000 seed weight (0.5936) followed by productive tillers per plant (0.2340) and finger length (0.1233) while the least value was observed for seed calcium content (0.0038).

In the third case when selection is not applied on days to maturity, the highest estimate of genetic advance was recorded 1000 seed weight (0.5762) followed by productive tillers per plant (0.2246) and finger length (0.1287) while the least value was observed for seed calcium content (0.0039).

In the fourth case where productive tillers per plant was not subjected to selection the highest estimate of genetic advance among the remaining ten characters was recorded by 1000 seed weight (0.5912) followed by finger length (0.1262) and seed protein content (0.1112) while the least value was observed for seed calcium content (0.0039).

In the fifth case when selection is restricted to ten characters leaving fingers per ear, the highest estimate of genetic advance was recorded by 1000 seed weight (0.5559) followed by productive tillers per plant (0.2010) and finger length (0.1328) while the least value was recorded by seed calcium content (0.0038).

In the sixth case where finger length is not considered for selection, the highest estimate of genetic advance among the remaining ten characters was recorded by 1000 seed weight (0.5604) followed by productive tillers per plant

(0.2189) and seed protein content (0.1040) and least by seed calcium content (0.0038).

In the seventh case when selection is restricted to ten characters without affecting ear weight per plant, highest estimate of genetic advance was recorded by 1000 seed weight (0.5790) followed by productive tillers per plant (0.1822) and finger length (0.1295) while the least value was observed for seed calcium content (0.0036).

In the eighth case when selection is imposed on the combination of ten characters which does not include 1000 seed weight, highest estimate of genetic advance was recorded by productive tillers per plant (0.2343) followed by finger length (0.1483) and fingers per ear (0.1129) and least value was observed by seed calcium content (0.0037).

In the ninth case when selection is restricted to the combination of ten characters which does not include seed protein content, highest estimate of genetic advance was recorded by 1000 seed weight (0.5930) followed by productive tillers per plant (0.2318) and finger length (0.1251) while the least value was observed for seed calcium content (0.0038).

In the tenth case when selection is restricted to the combination of ten characters which does not include seed calcium content, highest estimate of genetic advance was observed for 1000 seed weight (0.5800) followed by productive tillers per plant (0.2373) and finger length (0.1315). However plant height (0.0063) recorded least value of genetic advance.

In the eleventh case when selection is restricted to the combination of ten characters which does not include seed yield per plant, highest estimate of genetic advance was recorded by 1000 seed weight (0.5353) followed by productive tillers per plant (0.2018) and finger length (0.1198) while the least value was observed by seed calcium content (0.0039).

In all the above eleven cases of restricted selections, when inverse of means are used as economic weights, the character 1000-seed weight recorded highest estimate of genetic advance except when the same character is not consider for selection. The similar highest genetic advance values for 1000 seed weight were also reported by Padmaja *et al.,* 2007.

Another important finding of the present investigation is the occurrence of similar trend in both cases *i.e.,* by taking equal economic weights and using inverse of means of respective characters as economic weights. This indicates that both the ways of assigning weights were equally effective and will result in similar conclusions.

REFERENCES

1. *Jackson, M.L. 1967. Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi. pp: 282-289.*

2. *Kempthorne, O and Nordskog, A.W. 1959. Restricted selection indices. Biometrics. 15: 10-15.*

3. *Ministry of Agriculture. 2013. http://www.indiastat.com/agriculture/2/stats/asp*

4. *Padmaja, G., Panduranga Rao, C., Rama Kumar, P.V and Srinivas Rao, V. 2007. Restriction selection indices in VMEC group of genotypes of finger millet. The Andhra Agricultural Journal. 54(1&2): 16-20.*

5. *Sadasivam, S and Manickam, A. 1996. Biochemical Methods. Second edition, New Age International (P) Limited, Publishers. New Delhi. pp: 12-34.*

6. *Singh, R.K and Chaudhary, B.D. 2010. Biometrical Methods in Quantitative Genetic Analysis. Kalyani publishers, New Delhi. pp: 293-301.*

APPENDICES

Table 1: Genetic Advance Estimates (ΔG_i) in 11 Cases of Restricted Selections of 43 Genotypes of Finger Millet [*Eleusine Coracana* (L.) Gaertn.] when Equal Economic Weights are Assigned

Case No.	Character	Plant Height	Days to 50% Flowering	Days to Maturity	Productive Tillers per Plant	Fingers per ear	Finger Length	Ear Weight per Plant	1000-Seed Weight	Seed Protein Content	Seed Calcium Content	Seed Yield per Plant
1.	Plant height	0.0000	1.0677	0.8665	3.4130	-0.3985	-0.1007	0.7324	4.8458	1.0241	1.0077	0.6278
2.	Days to 50% flowering	0.5976	0.0000	1.0019	1.9566	-0.4393	0.0433	0.7818	4.5248	0.7740	1.0200	0.9748
3.	Days to maturity	0.6006	1.0554	0.0000	0.8275	0.1205	0.4812	0.7102	3.3888	0.6555	1.0212	1.0782
4.	Productive tillers per plant	0.6220	1.0813	0.9802	0.0000	-0.3521	0.2078	0.7017	4.1014	0.7326	1.0224	1.0961
5.	Fingers per ear	0.6001	1.0895	0.9603	1.0022	0.0000	0.2391	0.7257	3.1312	0.5835	1.0207	0.9841
6.	Finger length	0.6104	1.0589	0.9833	1.1134	-0.2911	0.0000	0.7311	3.4135	0.5921	1.0204	1.0294
7.	Ear weight per plant	0.6122	1.0573	0.9695	0.3292	-0.1770	0.2469	0.0000	3.8515	0.8142	1.0163	1.0359
8.	1000-seed weight	0.6156	1.1094	0.9437	1.4706	-0.0157	0.4761	0.7832	0.0000	0.5573	1.0195	1.1369
9.	Seed protein content	0.6219	1.0551	0.9851	1.2117	-0.4182	0.0530	0.7322	4.3931	0.0000	1.0202	1.0789
10.	Seed calcium content	0.5360	1.1012	0.9636	2.1599	0.9277	1.0651	0.6853	3.2891	0.3595	0.0000	0.7332
11.	Seed yield per plant	0.5707	1.0764	0.9878	1.9349	-0.3555	0.2022	0.7011	3.9961	0.5768	1.0213	0.0000

Table 2: Genetic Advance (ΔG_i) Values in 11 Cases of Restricted Selections of 43 Genotypes of Finger Millet [*Eleusine Coracana* (L.) Gaertn.] when Inverse of Means are Assigned as Economic Weights

Case No	Character	Plant Height	Days to 50% Flowering	Days to Maturity	Productive Tillers per Plant	Fingers per Ear	Finger Length	Ear Weight per Plant	1000-Seed Weight	Seed Protein Content	Seed Calcium Content	Seed Yield per Plant
1.	Plant height	0.0000	0.0124	0.0099	0.2464	0.0884	0.1229	0.0294	0.5992	0.1123	0.0037	0.0325
2.	Days to 50% flowering	0.0060	0.0000	0.0108	0.2340	0.0884	0.1233	0.0298	0.5936	0.1089	0.0038	0.0360
3.	Days to maturity	0.0062	0.0135	0.0000	0.2246	0.0955	0.1287	0.0294	0.5762	0.1079	0.0039	0.0368
4.	Productive tillers per plant	0.0079	0.0139	0.0102	0.0000	0.0796	0.1262	0.0246	0.5912	0.1112	0.0039	0.0401
5.	Fingers per ear	0.0062	0.0123	0.0110	0.2010	0.0000	0.1328	0.0294	0.5559	0.1060	0.0038	0.0341
6.	Finger length	0.0058	0.0113	0.0118	0.2189	0.0935	0.0000	0.0288	0.5604	0.1040	0.0038	0.0358
7.	Ear weight per plant	0.0063	0.0115	0.0106	0.1822	0.0957	0.1295	0.0000	0.5790	0.1142	0.0036	0.0359
8.	1000-seed weight	0.0068	0.0151	0.0079	0.2343	0.1129	0.1483	0.0345	0.0000	0.0992	0.0037	0.0421
9.	Seed protein content	0.0060	0.0126	0.0109	0.2318	0.0900	0.1251	0.0295	0.5930	0.0000	0.0038	0.0359
10.	Seed calcium content	0.0063	0.0123	0.0116	0.2373	0.0943	0.1315	0.0314	0.5800	0.1103	0.0000	0.0352
11.	Seed yield per plant	0.0048	0.0131	0.0122	0.2018	0.0732	0.1198	0.0261	0.5353	0.1113	0.0039	0.0000